the gardens of the Royal Botanic Society, Regent's Park, on July 23 and following days? It will be open to colleges and schools of every grade, and the exhibits will include all that bears upon Nature-study. Happily the project has secured very influential support, and has aroused considerable interest.

Sir John Cockburn, K.C.M.G., is chairman of the executive committee, and Mr. Charles Savile Roundell, of 7 Sussex Square, Brighton, is hon. treasurer.

I shall be happy to furnish full particulars, or to meet anyone, who may wish to see me personally, at any time by appointment either at the Botanic Gardens or in St. James's Street, S.W.

JOHN C. MEDD
(Hon. Sec. *pro tem.*).

Stratton, near Cirencester, March 19.

Sounds associated with Low Temperatures.

THE accompanying extract from a letter recently received from Norwich raises a question that I cannot answer. I have never experienced the fact named. Have any of your correspondents ever done so?

W. H. PREECE.

"On February 18 the temperature went down to zero here. As my son walked about the sheds, he was struck by the whistling noise the ground made, which he says he has noticed each time such an extremely low temperature has occurred, and he reminded me how we had once noticed it together a great many years ago. Now what makes that whistling, and does it always accompany a zero frost?"

Proofs of Euclid I. 5.

I REGRET that in my letter of March 13 (p. 439, line 4) the letters A, B were inadvertently used by me instead of B, C.

I have tried Mr. Croome-Smith's proof (NATURE, March 20, p. 466) on a class of beginners, but it is difficult to convince them that, in the words of the professional conjurer, "there is no deception."

A non-mathematical friend has just written, pointing out that so long as we define a square as a four-sided figure having all its sides equal and all its angles right angles, it is somewhat inconsistent to trouble the beginner with proving properties of an isosceles triangle the truth of which he can readily see for himself at a glance. Either we should make him prove the properties of a square or we might just as well define an isosceles triangle as a triangle having two sides equal, and the angles opposite these sides equal.

G. H. BRYAN.

THE NATIONAL PHYSICAL LABORATORY.

THE Prince of Wales, who was accompanied by the Princess, formally opened the National Physical Laboratory on March 19, in the presence of a distinguished company of men of science and others interested in national progress. In declaring the laboratory open, His Royal Highness said:—

I am glad that my first duty as a Fellow of the Royal Society should be to join with my distinguished brethren in opening this institution, the direction and administration of which have been entrusted to the Society by the Government. It is also a great pleasure to assist in the inauguration of what may fairly be called a new departure, for I believe that in the National Physical Laboratory we have almost the first instance of the State taking part in scientific research. The object of the scheme is, I understand, to bring scientific knowledge to bear practically upon our everyday industrial and commercial life, to break down the barrier between theory and practice, to effect a union between science and commerce. This afternoon's ceremony is not merely a meeting of the representatives of an ancient and world-renowned scientific society for the purpose of taking over a new theatre of investigation and research. Is it not more than this? Does it not show in a very practical way that the nation is beginning to recognise that if her commercial supremacy is to be maintained greater facilities must be given for furthering the application of science to commerce and manufacture? In the profession to which I am proud to belong there are, perhaps, special opportunities of gaining a certain insight into the general trade and commerce of the world and of comparing the commercial vitality of the different countries. And certainly abroad one finds an existing impression, which was confirmed by the experience of my recent and interesting colonial tour, that the superior technical and scientific knowledge of our foreign competitors is one reason why our hitherto preeminent position in manufactures and commerce is so considerably threatened. As a simple example I may quote the opinion of an expert authority in Australia, that the aniline dyes of Germany had given to a certain class of German-made goods a decided superiority over those of British manufacture. In Germany and America much valuable work has been carried out by the State. In this country the Government have provided these buildings and found machinery for the supply of light, heat and power. They are at present not inclined to spend more money upon equipping the laboratories. It is therefore to the liberality of the public that we must look, not only for money, but for presents in machinery and necessary appliances. Already the institution has benefited in the latter respect by gifts from Sir Andrew Noble, the Drapers' Company, Messrs. Willans and Robinson, Lady Galton, and others. The old-established Kew Observatory now forms part of the laboratory. Important and growing work is carried out in the testing of telescopes, binoculars, sextants and, more particularly, telescopic sights for the Navy. Most of the scientific outfit supplied for the Antarctic expedition was tested at Kew. The laboratory will also supply a want which is much felt for standardising and testing the many other forms of apparatus in daily use, while investigations will be carried out on points of importance to the manufacturer or the merchant from the solution of which valuable results may be expected to accrue. I am particularly pleased to know that it is possible that within the precincts of this laboratory there will be established a work of the utmost importance—namely, a tank after the design of the late Mr. Froude, in which the performance of a ship can be predicted from experiments on a model. At present there is such a tank at Haslar, which is fully occupied in Government work. The Institution of Naval Architects, impressed with the demand for this work, have proposed to raise the sum required to erect the tank and for the necessary appliances. But the funds at present at the disposal of the laboratory will require to be considerably supplemented if they are to undertake this much-needed work. No doubt the working expenses of the tank will ultimately be met by fees. But a difficulty may arise in tiding over the interval which must elapse before such fees are available. I am confident that, through the generosity of the public, the necessary means will be forthcoming to meet these difficulties and to secure that which is almost an essential to the shipbuilding industry of a country possessing the largest mercantile marine in the world. Before such an audience I have not presumed to speak of the value to science of this institution. Though the Navy has given many notable names to scientific theory, it is the practical results which naturally appeal more to the mind of the sailor, and I am sure you will accept this as my excuse for having ventured to make my few remarks upon the future of this institution from merely a utilitarian point of view.

At the close of the ceremony, in responding to the vote of thanks, the Prince of Wales announced that Sir William Armstrong, Whitworth and Co. had promised to subscribe 1000*l.* towards the funds of the laboratory; and he expressed the hope, which all of us share, that this excellent example will be promptly followed by other manufacturing firms. We give below some particulars of the work already instituted at the laboratory.

The opening ceremony took place in the engineering laboratory, in which about 900 guests were accommodated. This had been cleared for the occasion, and the only machines left in position were a shaping machine by Baker and Co., of Halifax, and a ten-ton testing machine. The latter is one of Messrs. Buckton's vertical machines. The stress is applied direct by means of a hydraulic ram worked off the main, in which there is about 100 feet of water pressure, so that no intensifier is necessary; the supply from a small cistern fixed to the wall is sufficient to bring the ram back when the pressure is relieved. The machine is intended primarily for experimental work in connection with the alloys research; for this it has conveniences which a more powerful instrument would not possess, while at the same time it may be useful in making accurate tests on small specimens; such tests the committee is prepared to undertake, though it fully recognises the desirability of erecting a large machine as soon as funds will permit. The usual accessories for torsion and bending tests are fitted; there is also a simple autographic gear.

The pressure pumps for the gauge-testing work supplied by Messrs. Schaffer and Budenberg were placed temporarily in an adjoining room. These are two in number; one is arranged to test simultaneously ten or twelve gauges up to a pressure of 600 lbs. to the square inch; the pressure is applied by a force pump and a screw plunger. In the other, a pressure of twelve tons to the square inch can be obtained easily. The indicator-testing apparatus given by Messrs. Willans and Robinson has not yet arrived. In the engine-room the 75 kilowatt Parsons' turbine was running, and proved an attraction to many visitors. The normal voltage of this machine is about 105. The room also contains a 10-kilowatt dynamo by Thomas Parker and Co., driven by a Crossley gas-engine and a motor generator set also by Parkers. By means of regulating resistances, the dynamo of this set can be made to run at voltages between 10 and 60. There are three storage batteries, each of about 55 chloride cells, in the Laboratory, and by running the generator in series with the main dynamo each of these can be charged. But in experimental work the cells are likely to be unequally used; the generator alone can then be used to charge groups of cells which require special treatment.

With regard to the physical part of the Laboratory, it must be remembered that the staff has only been in the building for a very short period, the electrical rooms were not ready for occupation until about ten days before the opening, and, further, that the funds at the disposal of the committee have sufficed to purchase only a limited equipment. The aim of the director has been to complete as far as possible the apparatus required for experiments which it is hoped to undertake at once; no apparatus has been bought without an express and immediate object in view. The thermometric department is perhaps the most completely fitted. The main laboratory has been divided into two by a partition of soft brick and glass. On the one side are the various furnaces and heating appliances, on the other the measuring instruments which it is desired to keep at a uniform temperature or to protect from fumes. The brick can easily be drilled to allow the passage of wires, tubes, &c.; through the glass the observer can see what is happening on the other side of the partition. Appliances were shown for standardising thermometric instruments from the temperature of liquid air up to 1000° C. or 1200° C. This laboratory is in the charge of Dr. Harker, who has shown much ability in arranging the various appliances.

For the liquid air there is a Hampson liquefier attached to a Brotherhood compressor, which is driven by a 5 h.p. motor by Laurence Scott and Co., of Norwich. For boiling-point observations and for calibration, the standard apparatus as used at Sèvres has been fitted. For temperatures between boiling point and 200° C. to 250° C. an oil bath has been constructed. This consists of a wide U-tube of copper having a junction across the upper part of the U. In the one limb is a stirrer driven by a small motor, in the other the thermometers are placed; thus a continuous stream of oil is driven rapidly past the thermometers. The whole is jacketed and heated by gas, and careful observations have shown that the temperature over the whole of the vertical column is remarkably uniform.

For temperatures up to about 600° C. there is a similar bath of iron containing a mixture in equal parts of the nitrates of potassium and sodium.

The higher temperatures up to nearly 1200° C. are obtained in an electric oven similar to that used by Messrs. Holborn and Day at the Reichsanstalt, and the director is indebted to President Kohlrausch for kind assistance in procuring the materials for this. The oven, which was the gift of Sir Andrew Noble, consists of a series of tubes of porcelain and fireclay carefully lagged with asbestos; round the innermost tube a nickel wire is coiled; this is heated by a current, and a remarkably steady and uniform condition of temperature is obtained; the regulation of the temperature is easy, and there are no fumes to contend with.

For success with the oven it is necessary that the electric supply should be uniform; a special battery of 56 cells has therefore been installed. This has been arranged in four groups of 14 cells each, and by means of a specially devised switchboard these can be combined in various ways to give the required current and voltage. This battery was the gift of Sir Andrew Noble, to whom also is due the gas thermometer which at present forms the standard of reference. For secondary standards, mercury thermometers will be used up to 250° or possibly rather higher; above this platinum thermometers, or possibly thermopiles, will be adopted. Among the exhibits were three thermal-junctions most carefully standardised by Prof. Holborn, which will form a link between the Laboratory and the Reichsanstalt; there was also a platinum thermometer in a quartz tube, very kindly given by Mr. W. A. Shenstone. A cathetometer set up temporarily against the wall attracted special notice.

At no great distance from the thermometric laboratory is the mercury pressure gauge. A glass column some fifty feet high has been fixed to the wall of the laboratory; alongside this is a steel scale, divided into millimetres, pounds per square inch, kilogrammes per square centimetre, and feet of water; thus gauges up to a pressure of 250 lbs. to the inch can be tested directly against the column. A lift erected close to the column enables the observer to read the height of the mercury. The pressure is applied by means of compressed air contained in a bottle connected both to the gauge and the mercury column. The bottle will be filled from the Brotherhood compressor which works the air liquefier. For standardising gauges between 250 and 400 lbs. pressure, a loaded piston apparatus—a gift from Messrs. Willans and Robinson—will be available; for pressures above this, apparatus has to be constructed.

The metallurgical department is housed in the old kitchen, in which there was an interesting exhibition of photographs of metallic sections and cooling curves, lent by Sir William Roberts-Austen. The apparatus for investigating cooling curves has yet to be bought, but a beautiful photomicrographical outfit by Zeiss was shown by Dr. Carpenter, who exhibited to a number of the guests the section of a steel rail magnified four hundred times; the pearlite and ferrite structures were clearly visible; the rail had been rolled cold and the grains were elongated by the rolling. The projection apparatus is very complete; the arrangements for cutting, grinding and polishing the sections are also ready; the polishing apparatus has been specially designed by Mr. J. E. Stead, and the laboratory is prepared to undertake the microscopic examination of sections for the railway companies or other users.

A room adjoining the microscopeis arranged for metrology, and here were set up a dividing engine by the Société Génevoise pour la Construction d'Instruments de Physique. This instrument was given by Sir Andrew Noble, and is a copy of that in use at the Bureau International, but without the automatic mechanism—this, however, can be added if funds permit. It will divide lengths of 1 metre or less. The room also contained a Whitworth measuring machine, a set of standard gauges, surface plates, &c. A set of screw gauges had most kindly been lent by

Messrs. Sir W. G. Armstrong, Whitworth and Co., who exhibited in addition Sir J. Whitworth's original measuring machine. A Pratt and Whitney measuring machine has not yet arrived. In an adjoining room, thanks to the courtesy of Sir F. J. S. Hopwood and Mr. Chaney, there was an interesting exhibit from the Standards Department of the Board of Trade. King Henry VII.'s yard and Queen Elizabeth's pints were shown in proximity to our modern standards.

The electrical rooms are three in number. One of these, in the basement, has a constant-temperature chamber attached, and here were the British Association standards of resistance; the coil "Flat" made by Matthiessen about 1864 and used by the original British Association Committee on Electrical Standards was shown to visitors, as well as some modern standards.

The main electrical laboratories, however, are far from complete; one of these, which is to be used for the fundamental units and standards, was occupied as a tea-room. In the other, Mr. Campbell had, in the ten days which had been available, set up some secondary standards in their permanent positions, while other apparatus was exhibited on tables in the middle of the room. A few antiquated scales of historical interest aroused some criticism. They were merely placed on the tables with the other apparatus to indicate that a galvanometer with some proper arrangement of lamp and scale formed part of the installation required.

The fundamental standard of electromotive force will be the Clark cell, while current will be measured by the drop in volts over a known resistance; but for secondary standards a Kelvin multicellular voltmeter of somewhat special construction, a set of Kelvin balances and some Weston instruments will be employed. The voltmeter is read on a long scale in the form of the arc of a circle some two metres in radius. Between 60 and 110 or 120 volts the scale is a very open one, some 5 cm. corresponding to one volt. Thus it is easy to read to the tenth of a volt. For use with the instrument a special resistance box containing ten coils has been wound by Mr. Campbell.

The first coil of 10,000 ohms resistance is divided into two parts. One of these has a resistance of 1500, the other of 8500 ohms; each of the others is 10,000 ohms. Each coil is of manganin, wound in sections, which are arranged so as to be non-inductive, and each coil will stand an E.M.F. of more than 100 volts. Thus 1000 volts may safely be applied to the whole. A current can be passed through the whole box and adjusted by means of external resistances until the drop between the first and second terminal just balances the E.M.F. of one Clark cell—14,340 volts—in series. In this case the drop across each coil after the first is 10 volts, and by connecting the voltmeter in turn to the proper terminals of the box its scale can be calibrated. When this has been done the instrument is ready for reading directly potential differences between 50 and 120 volts; below 50 the scale is too contracted. To measure voltages above 120 volts, the box is used; the total volts are put on between the end terminals; the box enables these to be subdivided to tenths, and a convenient number of tenths can be measured directly on the voltmeter scale.

In another corner of the room were the standard air condensers of the British Association; these, which consist of a series of concentric cylinders, have been described by Mr. Glazebrook in some of the reports of the Electrical Standards Committee; on a table near by was shown the apparatus for determining their capacity, a Wheatstone's bridge box of platinum silver coils by Elliott Bros. and a rotating commutator made by Pye and Son, of Cambridge, the speed of which is controlled by a stroboscopic arrangement viewed through diaphragms attached to a standard fork.

It is intended at once to set about constructing from these condensers standards of capacity for commercial use.

On another table was set up in a convenient form the apparatus for measuring by the ballistic method the permeability and hysteresis of an iron ring, while close by the latest pattern of Ewing's permeameter was on exhibition.

In the centre of the room were shown two resistance boxes by Wolff, of Berlin; one of these was a potentiometer box with a wide range of applicability, the other an ingenious modification of the Kelvin double bridge which is used extensively at the Reichsanstalt for the measurement of small resistances.

The commercial testing of iron and steel or of measuring apparatus, if undertaken on a large scale, will probably be carried out ultimately in a room attached to the engineering laboratory; most of the arrangements which have just been described are fitted rather for the construction and verification of secondary standards than for purely commercial testing.

A fourth wing of the building contains the chemical laboratory, which calls perhaps for no particular description; it was described as workmanlike by a very capable judge on the nineteenth, and that may suffice. A chemical laboratory is essential, but it is not desirable that it should be very elaborate.

The laboratory contained a large collection of glass vessels, flasks, burettes, &c., lent by Messrs. Gallenkamp; these were intended to illustrate one branch of the new work, the standardisation of such apparatus for which there seems a great opening. The vessels exhibited bore the stamp of the Reichsanstalt.

The system of electric wiring adopted requires a special notice. There are two distinct sets of circuits; one of these, connected to the lamps and to numerous plug points, is fed from the dynamo or the cells at a steady voltage of 100 volts. It is used for lighting and for the supply of power.

For the experimental work there is a separate battery of 55 cells. These are arranged in groups of 5, the first group being further subdivided; the positive poles of the cells are connected to a series of horizontal brass bars at the back of the main switchboard; the negative poles are connected to a series of isolated blocks, which, by means of switches on the front of the board, can be put into contact with the corresponding horizontal bars; the positive pole of each group is one bar lower than the negative pole of the same group. Thus if the switches are all closed the cells are in series; the top horizontal bar is negative, and there is a constant rise of 10 volts between each two consecutive bars. On the front of the board are a series of vertical bars, and from the tops of these the experimental circuits, of which there are thirty, lead away through fuses. These vertical bars can be plugged through to the horizontal bars at the back, and thus a series of voltages rising by steps of 10 volts can be distributed through the building.

The normal discharge rate of the cells is 50 amperes, but to obtain higher rates the cells can be connected in groups of five in parallel. To do this with all the groups, all the switches are opened; two specially heavy vertical bars are then connected by plugs, the one to all the positive poles, the other to all the negative poles of the battery. From these bars two circuits capable of taking 500 amperes lead away.

The switchboard, which is a modification of that at the Owens College Laboratory, was designed by Mr. G. A. Steinthal, of Bradford, in accordance with the suggestions of the director. Mr. Steinthal has carried out all the experimental wiring. The distributing wires are for the most part bare copper, and are carried on porcelain insulators. Some of these wires go directly to the various rooms, and are so arranged that it is possible in any room to obtain simultaneously at least two different voltages. Others of the distributing wires go to three subboards arranged in a similar manner to the main board; four circuits from the main board go to each subboard, and twelve subsidiary circuits leave it. In the main electrical laboratories there are five of these subcircuits, and to avoid magnetic action concentric wiring has been used in the section. Each board is fitted with a voltmeter, so that the voltage can be tested before connection is made with any instruments. Thus the electrical equipment, so far as it goes, is unusually complete. It should be noted, however, that provision is still required for alternating current supply and for voltages above 110 volts. Arrangements have been made by which the experimental battery can be put on to the lighting circuit, or run in series with the lighting battery to get 220 volts, but it is not anticipated that this will often be done. As soon as funds permit, the outfit will need supplementing in this respect.

It will appear from the above that there is much to be done before the Laboratory can be called complete; still, for many branches of its work it has the means to start, and its success in these will lead to increased opportunities for development.

THE SCENERY OF ENGLAND.[1]

IT is curious to reflect on the history of man's inquiry into the origin of the landscapes among which he has lived for so many thousand years, and to find how recent is his intelligent interest in the subject. Within the memory of many who are still alive and active, the present topography of the land hardly came within the scope of scientific investigation, and while the utmost energy and enthusiasm were displayed in unravelling the secrets of the rocks below the surface and thus reconstructing the geography and scenery of the successive eras of the geological past, only meagre attention was given to the causes which had brought about the existing features of that surface. The popular notion that everything remained as it had been from the beginning was known to be untenable and absurd; nevertheless, the subject failed to excite the interest of geologists as a body. Some of them were Wernerian tories, others Plutonist conservatives or Uniformitarian liberals; but whatever might be their geological creed, they were for the most part Gallios in this matter, never caring to set themselves seriously to consider how their familiar hills and valleys were in detail to be accounted for.

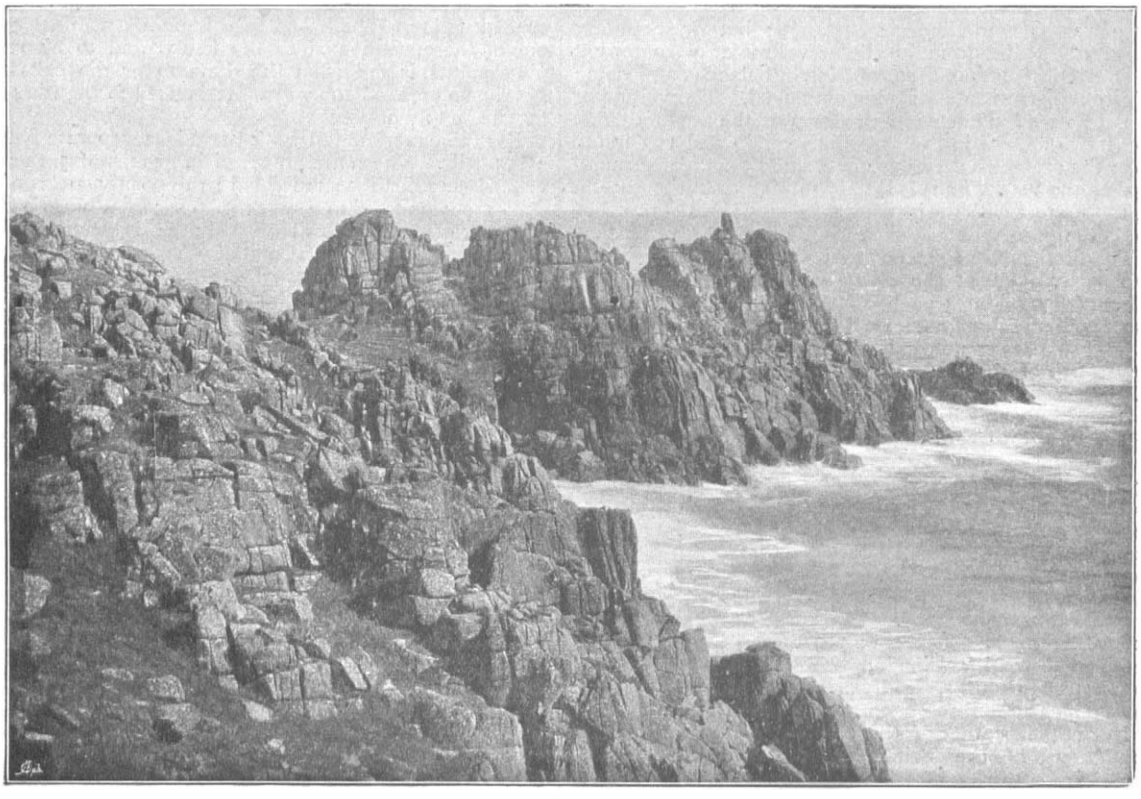

FIG. 1.—Granite Coast, Cornwall.

Yet the way had been shown to them generations before. It had been opened up by Lazzaro Moro and Generelli in Italy; by Ray and afterwards by Hutton and Playfair in this country; and by Guettard and Desmarest in France. Living on an island and accustomed to continual tales of the destruction wrought by the sea on the margin of the land, British geologists, largely influenced in later years by Lyell, had come to look upon the sea as the prime agent in the degradation of the terrestrial surface. They had no theoretical objection to depressing or uplifting the land to any extent that might be desired, in order to account by marine erosion for any particular topographical feature. While admitting the existence of what were called "valleys of denudation," they thought it much more probable that these hollows had been scooped out by violent inundations of the sea, or by ocean currents moving with great velocity over the submerged country, than that they could have been carved out by such seemingly feeble agents as the rivers that flow in them. The admirable demonstration given by Desmarest, as far

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[1] "The Scenery of England and the Causes to which it is Due." By the Right Hon. Lord Avebury. Pp. xxvi + 534. (London: Macmillan and Co., Ltd.) Price 15*s*. net.